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User Manual EE160

Humidity and Temperature Sensor for Building Automation

Modbus

www.epluse.com

Content

1 General Information

This user manual serves for ensuring proper handling and optimal functioning of the device. The user manual shall be read before commissioning the equipment and it shall be provided to all staff involved in transport, installation, operation, maintenance and repair. E+E Elektronik Ges.m.b.H. does not accept warranty and liability claims neither upon this publication nor in case of improper treatment of the described products.

This document may contain technical inaccuracies and typographical errors. The content will be revised on a regular basis. These changes will be implemented in later versions. The described product(s) can be improved and changed at any time without prior notice.

The user manual may not be used for the purposes of competition without the written consent of E+E Elektronik Ges.m.b.H. and may not be forwarded to third parties. Copies may be made for internal purposes. All information, technical data and diagrams included in these instructions are based on the information available at the time of writing.

PLEASE NOTE

Find this document and further product information on our website at www.epluse.com/ee160.

1.1 Explanation of Warning Notices and Symbols

Safety precautions

Precautionary statements warn of hazards in handling the device and provide information on their prevention. The safety instruction labeling is classified by hazard severity and is divided into the following groups:

DANGER

Danger indicates hazards for persons. If the safety instruction marked in this way is not followed, the hazard will verly likely result in severe injury or death.

WARNING

Warning indicates hazards for persons. If the safety instruction marked in this way is not followed, there is a risk of injury or death.

CAUTION

Caution indicates hazards for persons. If the safety instruction marked in this way is not followed, minor or moderate injuries may occur.

NOTICE

Notice signals danger to objects or data. If the notice is not observed, damage to property or data may occur.

Informational notes

Informational notes provide important information which stands out due to its relevance.

INFO

The information symbol indicates tips on handling the device or provides additional information on it. The information is useful for reaching optimal performance of the device.

The title field can deviate from “INFO” depending on the context. For instance, it may also read “PLEASE NOTE”.

1.2 Safety Instructions

1.2.1. General Safety Instructions

NOTICE

Improper handling of the device may result in its damage.

- The device and mainly the filter cap shall not be exposed to unnecessary mechanical stress.
- When replacing the filter cap make sure not to touch the sensing elements.
- The device must be operated with the filter cap on at all times.
- Installation, electrical connection, maintenance and commissioning shall be performed by qualified personnel only.
- Use the EE160 only as intended and observe all technical specifications.
- Do not apply the nominal voltage to the RS485 data lines.

1.2.2. Intended Use

The EE160 is intended for the relative humidity (RH) and temperature (T) measurement in building automation.

The measured data is available on two voltage or current (2-wire) outputs, or on the RS485 interface with Modbus RTU protocol. Additionally, the EE160 features a passive T output and an optional display visualises RH and T values simultaneously.

⚠ WARNING

Non-compliance with the product documentation may cause safety risks for people and the entire measurement installation.

The manufacturer cannot be held responsible for damages as a result of incorrect handling, installation and maintenance of the device.

- Do not use EE160 in explosive atmosphere or for measurement of aggressive gases.
- This device is not appropriate for safety, emergency stop or other critical applications where device malfunction or failure could cause injury to human beings.
- The device may not be manipulated with tools other than specifically described in this manual.

NOTICE

Failing to follow the instructions in this user manual may lead to measurement inaccuracy and device failures.

- The EE160 may only be operated under the conditions described in this user manual and within the specification included in chapter 8 Technical Data.
- Unauthorized product modification leads to loss of all warranty claims. Modification may be accomplished only with an explicit permission of E+E Elektronik Ges.m.b.H.!

1.2.3. Mounting, Start-up and Operation

The EE160 has been produced under state of the art manufacturing conditions, has been thoroughly tested and has left the factory after fulfilling all safety criteria. The manufacturer has taken all precautions to ensure safe operation of the device. The user must ensure that the device is set up and installed in a way that does not impair its safe use. The user is responsible for observing all applicable local and international safety guidelines for safe installation and operation of the device. This user manual contains information and warnings that must be observed by the user in order to ensure safe operation.

PLEASE NOTE

The manufacturer or his authorized agent can be only be held liable in case of willful or gross negligence. In any case, the scope of liability is limited to the corresponding amount of the order issued to the manufacturer. The manufacturer assumes no liability for damages incurred due to failure to comply with the applicable regulations, operating instructions or the specified operating conditions. Consequential damages are excluded from the liability.

WARNING

Non-compliance with the product documentation may cause accidents, personal injury or property damage.

- Mounting, installation, commissioning, start-up, operation and maintenance of the device may be performed by qualified staff only. Such staff must be authorized by the operator of the facility to carry out the mentioned activities.
- The qualified staff must have read and understood this user manual and must follow the instructions contained within.
- All process and electrical connections shall be thoroughly checked by authorized staff before putting the device into operation.
- Do not install or start-up a device supposed to be faulty. Make sure that such devices are not accidentally used by marking them clearly as faulty.
- A faulty device shall be removed from the process.
- Service operations other than described in this user manual may only be performed by the manufacturer.

1.3 Environmental Aspects

PLEASE NOTE

Products from E+E Elektronik Ges.m.b.H. are developed and manufactured in compliance with all relevant environmental protection requirements. Please observe local regulations for the disposal of the device.

For disposal, the individual components of the device must be separated according to local recycling regulations. The electronics shall be disposed of correctly as electronics waste.

1.4 ESD Protection

The sensing elements and the electronics board are ESD (electrostatic discharge) sensitive components of the device and must be handled as such. Failure to do so may damage the device by electrostatic discharge when touching exposed sensitive components.

2 Scope of Supply

Model	EE160 Wall mount (Type T1)	EE160 Duct mount (Type 2)	Additionally for all EE160 with RS485 interface
EE160 Humidity and Temperature Sensor according to order code	✓	✓	
Cable gland	✓	✓	✓
Mounting kit	✓	✓	
Mounting flange		✓	
Inspection certificate according to DIN EN 10204-3.1	✓	✓	
Quick Guide - EE160 RS485 Setup			✓

Tab. 1 Items included in the scope of supply

3 Product Description

3.1 General

The EE160 sensor is optimized for cost effective, accurate measurement of RH and T in building automation.

The measured data is available on

- Two voltage or current (2-wire) outputs
- The RS485 interface with Modbus RTU protocol
- A passive T output

Furthermore an optional display visualises RH and T values simultaneously.

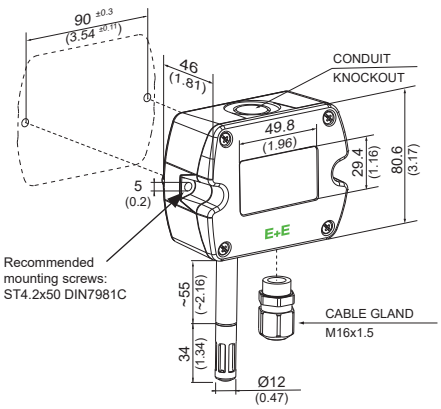
Both, the wall mount and the duct mount model come with an IP65 / NEMA 4X enclosure which provides minimal installation costs and reliable protection against contamination and condensation. The encapsulated electronics in the probe and the E+E sensor coating ensure long-term stable and accurate measurements.

The user can set the RS485 interface parameters, the output scaling and perform 1- or 2-point adjustment for RH and T with an optional configuration adapter and the free PCS Product Configuration Software.

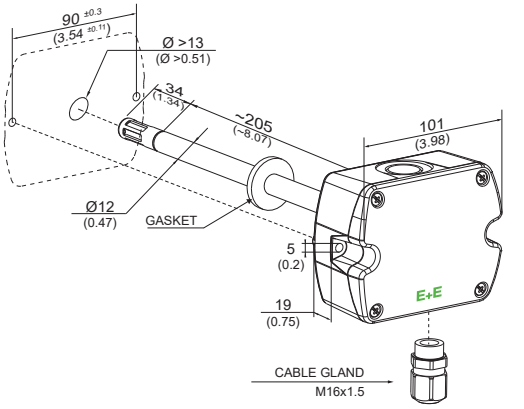
3.2 Dimensions

Values in mm / inch

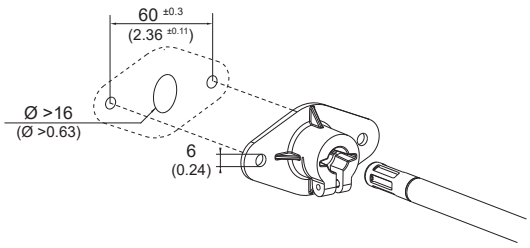
Type T1 wall mount



Type T2 duct mount



Mounting flange
in the scope of supply for type T2



3.3 Electrical Connection

EE160 features screw terminals for connecting the power supply and the outputs. The cables are fed into the enclosure through the M16 cable gland.

NOTICE

It is important to make sure that the cable glands are closed tightly for the power supply and outputs cable. This is necessary for assuring the IP rating of the enclosure according to EE160 specification, as well as for stress relief at the screw terminals on the EE160 board.

⚠ WARNING

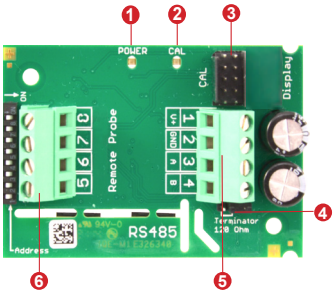
Incorrect installation, wiring or power supply may cause overheating and therefore personal injuries or damage to property.

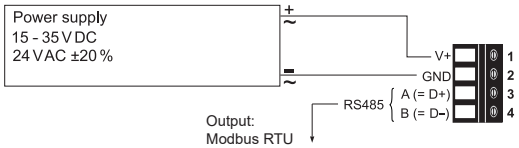
It is essential that the cables are not under voltage during installation. No voltage must be applied when the product is connected or disconnected. For correct cabling of the device, always observe the presented wiring diagram for the product version used.

The manufacturer cannot be held responsible for personal injuries or damage to property as a result of incorrect handling, installation, wiring, power supply and maintenance of the device.

Connection Diagram

EE160-M1TxJ3



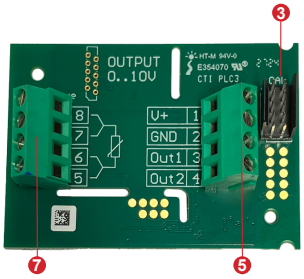


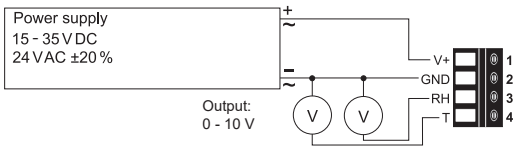
PLEASE NOTE

Bus Termination:

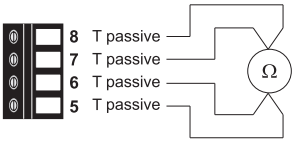
If required, the RS485 bus termination can be realized with 120 Ω resistor, jumper on the board.

EE160MxTxA3

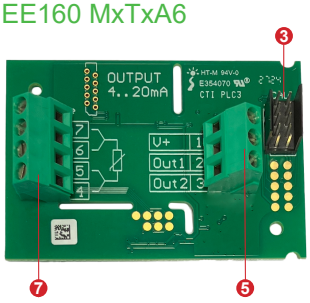


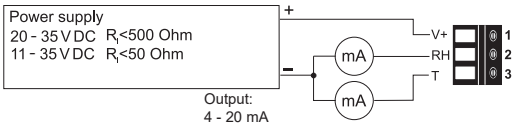


T-passive connection for M8TxA3



EE160 MxTxA6





T-passive connection for M8TxA6

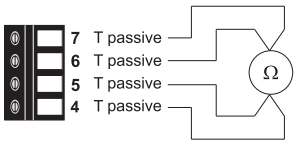


Fig. 1 EE160 connection options

No.	Function
1	Green LED Information during operation On normal operation Flashing the main board does not recognize the probe's measurement electronics Off no power supply or main board failure
2	Blue LED Information during setup with the optional USB configuration adapter HA011066 and the PCS Product Configuration Software On USB connection to PC, no communication with PCS Flashing communication with PCS in progress Off no USB connection to PC
3	Connector for configuration adapter
4	Bus termination resistor 120 Ω (jumper)
5	Screw terminals for power supply and outputs
6	Screw terminals, do not connect
7	Screw terminals for T passive output

Tab. 2 Parts of the EE160 electronics board types

3.4 Display

The optional display is available for both, wall mount (T1) and duct mount (T2) types and shows RH and T values simultaneously in two lines.

The PCS10 allows the user to set warning thresholds for RH and T, above which the measured values start to flash. Refer to chapter 5 Setup and Configuration for details.

PLEASE NOTE

The display included in the top part of the enclosure is available as spare part D10P, intended for replacement only, not for retrofitting an EE160 originally ordered without display.

PLEASE NOTE

The EE160-xA6 (4 - 20 mA, 2-wire version) with display only operates correctly if both outputs are connected.

4 Mounting and Installation

For mounting, the cable gland (in the scope of supply) onto the EE160 enclosure use a matching wrench. When using EE160 with conduit connection for the North American market use a flat screwdriver to knock open the blind at the top of the enclosure, carefully. Take good care to avoid damaging the electronics inside the enclosure. The conduit adapter is not included in the scope of supply. The M16x1.5 opening for the cable gland shall be tightly closed using the blind plug included in the scope of supply (refer to also chapter 3.2 Dimensions).

PLEASE NOTE

For best measurement results, the EE160

- must be installed in an environment where the medium to be measured flows sufficiently around the probe.
- temperature of the sensing probe and mainly of the sensing head is the same as the temperature of the air to measure. Avoid mounting the EE160 sensor in a way which creates temperature gradients along the probe.
- shall not be placed near influencing objects such as heating radiators or fan heaters.
- self-heating effects are compensated, @24 V DC and 250 Ω load resistance for A6 versions.

5 Setup and Configuration

The EE160 is ready to use and does not require any configuration by the user. The factory setup of EE160 corresponds to the type number ordered. Please refer to the data sheet at www.epluse.com/ee160. The user can change the factory setup with the help of the Product Configuration Software and the USB configuration adapter.

Besides the output scaling the user can change the communication settings for digital interface and perform one or two point adjustment for humidity and temperature. Additionally warning thresholds for RH and T display visualization can be set.

From 01/2023, the EE160 is equipped with a new sensing element. Before you start configuring the EE160, check which sensing element it is equipped with.

5.1 Product Configuration of the EE160 with new Sensing Element

Remove the filter cap and check the sensing element of your EE160.

Fig. 2 EE160 with new sensing element

If the EE160 is equipped with a new sensing element according to the picture above, it must only be configured or adjusted using the PCS10 Product Configuration Software (free download from www.epluse.com/pcs10) and the adapters according to the following table:

Version	EE160 new sensing element	
	Configuration hardware	Configuration software
EE160-MxTxA3 **Analogue voltage 0...10 V**	HA011070	PCS10
EE160-MxTxA6 **Analogue voltage 4...20 mA**	HA011070	PCS10
EE160-M1TxJ3 **Digital RS485 Modbus**	HA011070[1)]	PCS10

1) Or HA011066 (not intended for new designs)

5.1.1. EE160 Configuration using HA011070

NOTICE

The USB-C configuration stick HA011070 galvanically isolates the USB interface of the PC from the supply voltage of the EE160. When using the USB-C configuration stick the EE160 needs external supply.

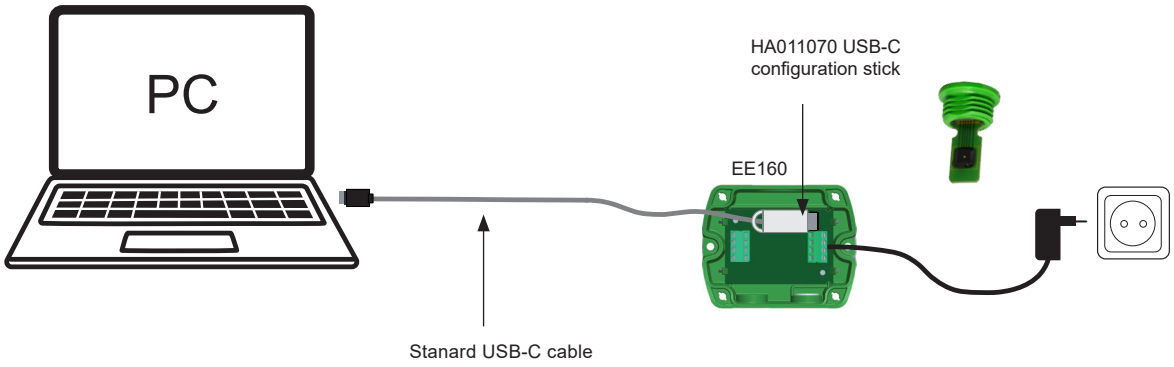


Fig. 3 EE160 configuration using the HA011070 USB-C configuration stick

5.1.2. EE160-M1TxJ3 (Digital Interface) Configuration Using HA011066 (not Intended for New Designs)

NOTICE

- For configuration of the EE160 with digital interface, using HA011066 either the supply of the configuration adapter HA011066 (for configuration purposes) or an external supply (for configuration, calibration and adjustment purposes) must be used.
- It is not permitted to use both (external supply and configuration adapter supply) at the same time.
- For best results the use of an external power supply is recommended for calibration and adjustment purposes.

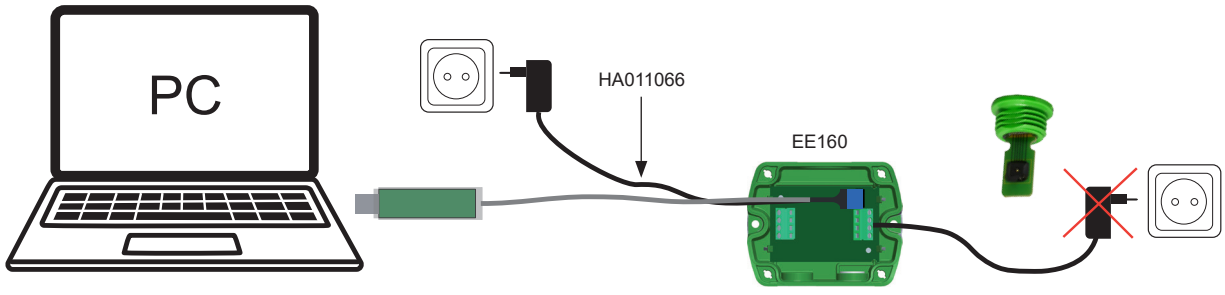


Fig. 4 EE160 configuration (digital interface) using the supply of HA011066

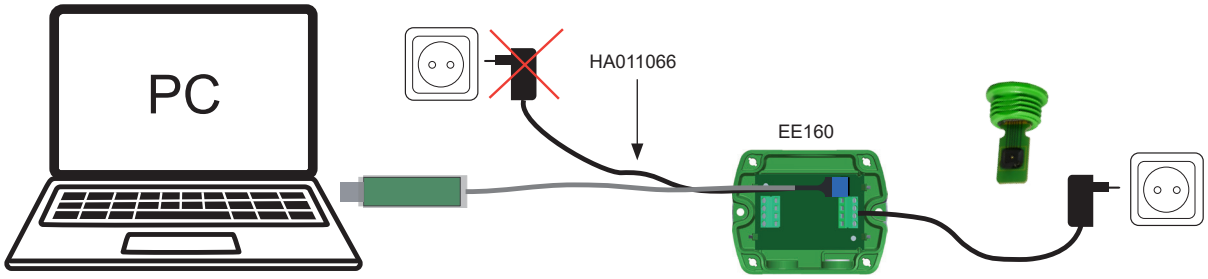


Fig. 5 EE160 configuration (digital interface) using the external supply

5.2 Product Configuration Adapter and Software for EE160 with New Sensing Element and Legacy Configuration Adapter HA011069 (not Intended for New Designs)

Remove the filter cap and check the sensing element of your EE160.

Fig. 6 EE160 with new sensing element

If the EE160 is equipped with a new sensing element according to the picture above it must only be conifgured or adjusted using the PCS10 Product Configuration Software (free download from www.epluse.com/pcs10.

EE160 analogue versions can be configured using the legacy configuration adapter HA011069 (not intended for new designs) see table below.

Version	EE160 new sensing element	
	Configuration adapter	Configuration software
EE160-MxTxA3 **Analogue voltage 0...10 V**	HA011069	PCS10
EE160-MxTxA6 **Analogue voltage 4...20 mA**	HA011069	PCS10

Fig. 7 EE160 new sensing element

The USB configuration adapter HA011069 comes with a USB isolator that galvanically isolates the USB interface of the PC from the supply voltage of the EE160.

PLEASE NOTE

The USB configuration adapter HA011069 must always be operated together with the USB isolator.

5.2.1. EE160-MxTxA3 (Analogue Output, Voltage Version) with HA011069

NOTICE

- For the EE160 with voltage output, either the supply of the configuration adapter (for configuration purposes) or an external supply (for configuration, calibration and adjustment purposes) must be used.
- It is not permitted to use both (external supply and configuration adapter supply) at the same time.
- For best results the use of an external power supply is recommended for calibration and adjustment purposes.

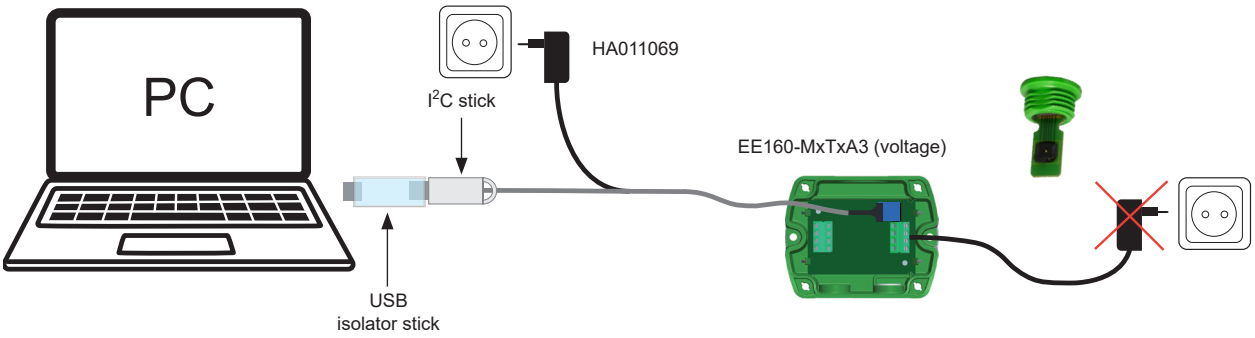


Fig. 8 EE160 configuration voltage output using HA011069 supply

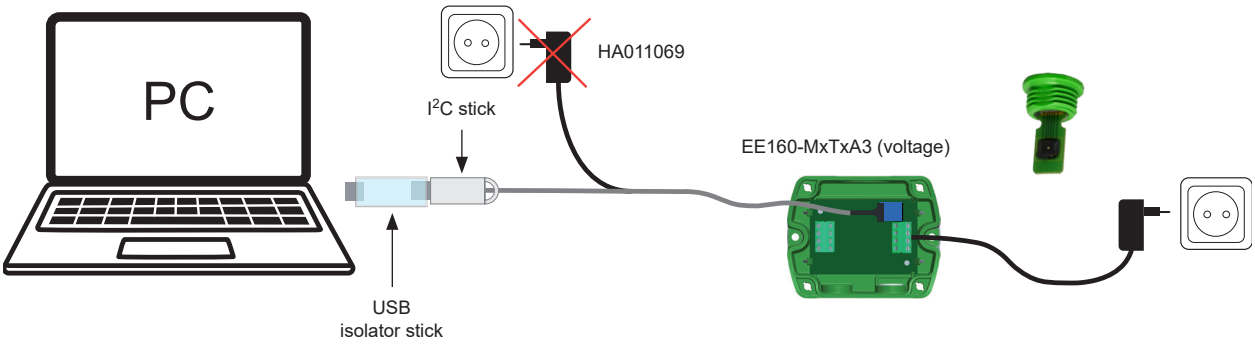


Fig. 9 EE160 configuration voltage output using external supply

5.2.2. EE160-MxTxA6 (Analogue Output, Current Version) with HA011069 (not Intended for New Designs)

NOTICE

- For the EE160 with current output an external supply must be used for configuration, calibration and adjustment purposes.
- It is not permitted to use the configuration adapter supply (only for voltage output).
- It is not permitted to use both (external supply and configuration adapter supply) at the same time.

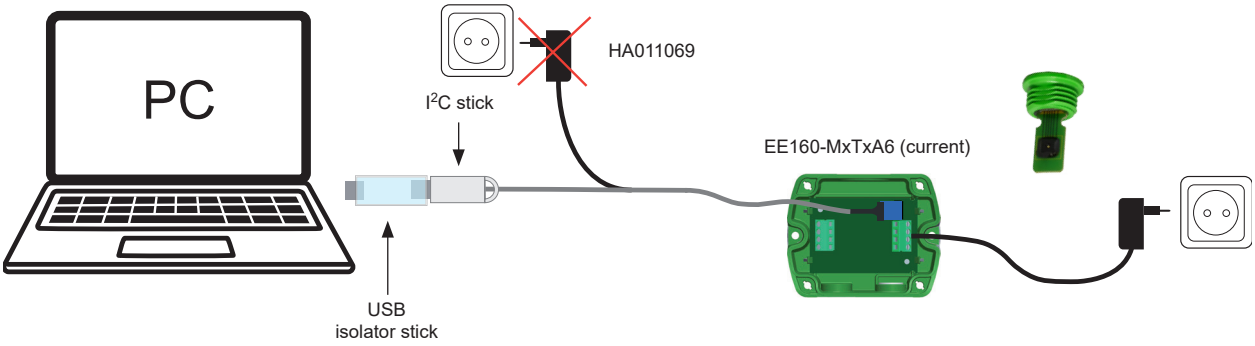


Fig. 10 EE160 configuration current output using external supply only

5.3 Product Configuration Adapter and Software for EE160 with Legacy Sensing Element

Remove the filter cap and check the sensing element of your EE160.

Fig. 11 EE160 with legacy sensing element

If the EE160 is equipped with a legacy sensing element according to the picture above, it must only be configured or adjusted using the EE-PCS Product Configuration Software (free download from www.epluse.com/configurator) and the adapters according to the following table:

Version	EE160 legacy sensing element	
	Configuration adapter	Configuration software
EE160-MxTxA3 **Analogue voltage 0...10 V**	EE-PCA + HA011059	EE-PCS
EE160-MxTxA6 **Analogue voltage 4...20 mA**	EE-PCA + HA011059	EE-PCS
EE160-M1TxJ3 **Digital RS485 Modbus**	HA011066	EE-PCS

Fig. 12 EE160 legacy sensing element

5.3.1. EE160-MxTxAx (Analogue Output)

NOTICE

EE160 with analogue output must be powered externally when using the EE-PCA kit.

Fig. 13 EE160 configuration analogue output using EE-PCA kit

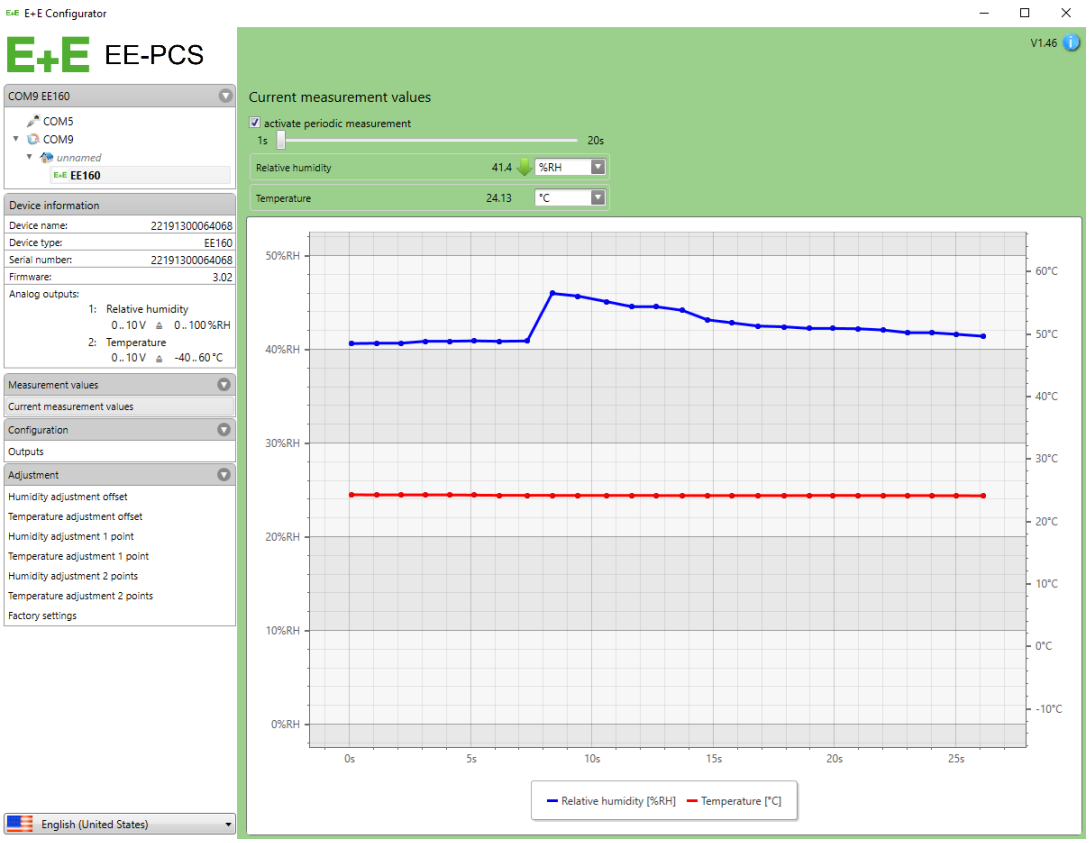


Fig. 14 EE-PCS software for analogue versions

5.3.2. EE160-M1TxJ3 (Digital Interface)

NOTICE

- For the EE160 with digital interface, either the supply of the configuration adapter HA011066 (for configuration purposes) or an external supply (for configuration, calibration and adjustment purposes) must be used.
- It is not permitted to use both (external supply and configuration adapter supply) at the same time.
- For best results the use of an external power supply is recommended for calibration and adjustment purposes.

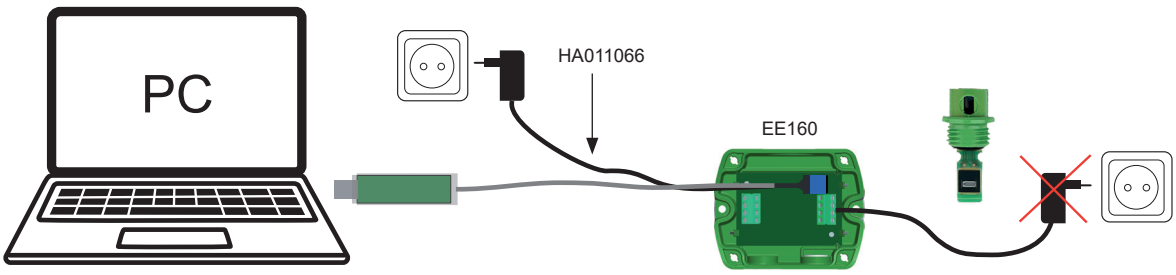


Fig. 15 EE160 configuration (digital interface) using the supply of HA011066

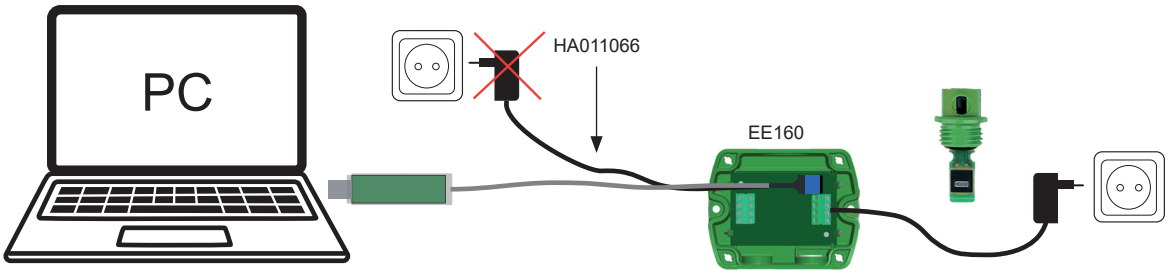


Fig. 16 EE160 configuration (digital interface) using external supply

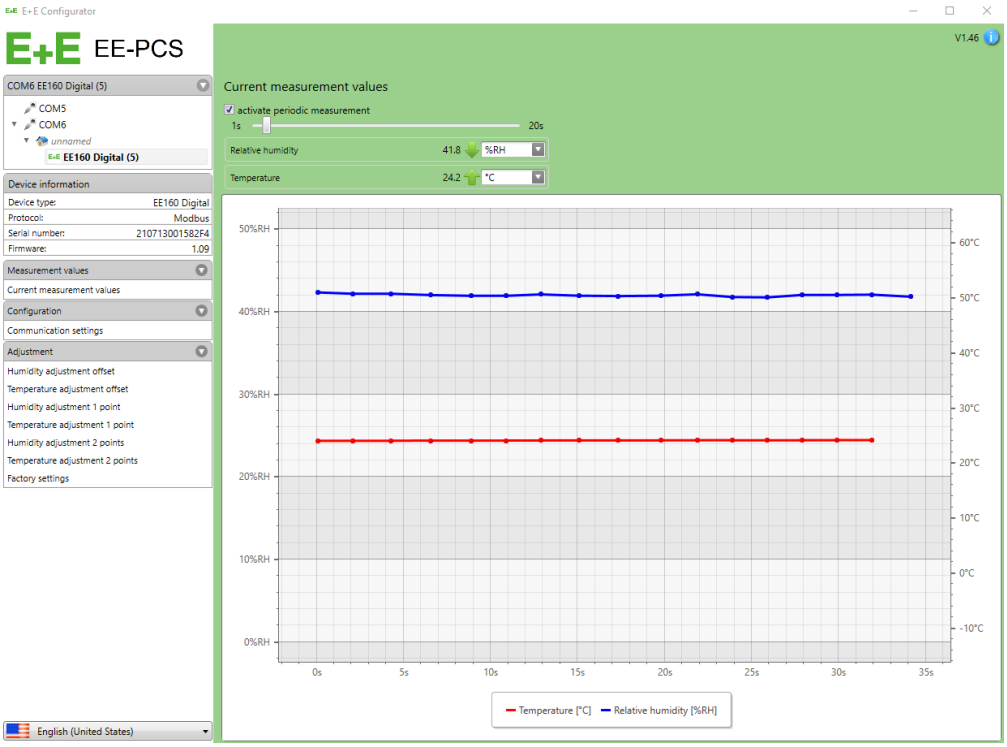


Fig. 17 EE-PCS software for digital interface

5.4 PCS10 Product Configuration Software

To use the software for performing adjustments and changes in settings, please proceed as follows:

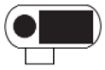
1. Download the PCS10 Product Configuration Software from www.epluse.com/pcs10 and install it on the PC.
2. Connect the EE160 to the PC using the appropriate configuration adapter.
3. Start the PCS10 software.
4. Follow the instructions on the PCS10 opening page for scanning the ports and identifying the connected device
5. Click on the desired setup mode from the main PCS10 menu on the left. Follow the online instructions of the PCS10 which are displayed when clicking the “Tutorial” button.
6. Changes are uploaded to the sensor by pressing the “Sync” button.

5.5 RS485 Digital Interface

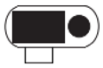
5.5.1. Hardware Bus Termination

For bus termination EE160 features an internal 120 Ω resistor which can be activated using the jumper on the electronics board (refer to also chapter 3.3 Electrical Connection for details).

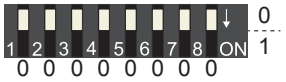
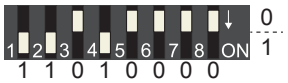
- Jumper not mounted (right position = factory setup): bus is not terminated



- Jumper mounted (left position): bus is terminated



5.5.2. Device Address

Address Switch	Option
	**Address setting via PCS10 Product Configuration Software (= factory setting)** All DIP switches at position 0 → factory-set default address (245_{DEC}, 0xF5) applicable, can be changed via software (PCS10 or Modbus protocol, permitted values: 1…247). Example: Address is set via configuration software.
	**Address setting via DIP switches** DIP switches in any other position than 0 indicate the effective Modbus address which overrules the factory setting and any Modbus address set via PCS10 or Modbus command (permitted values: 1…247). Example: Address set to 11_{DEC} ($0000\ 1011_{BIN}$).

5.5.3. RS485 Digital Interface with Modbus RTU Protocol

	Factory settings	User selectable values (via PCS10)
Baud rate	9600	9 600, 19 200, 38 400, 57 600, 76 800, 115 200
Data bits	8	8
Parity	Even	None, odd, even
Stop bits	1	1, 2
Modbus address	245	1…247

Tab. 3 Digital interface default settings

The recommended settings for multiple devices in a Modbus RTU network are 9600, 8, even, 1.
The EE160 represents 1 unit load on an RS485 network.

Device address, baud rate, parity and stop bits can be set via:

- PCS10 Product Configuration Software, the USB configuration adapter HA011066.
  The PCS10 can be downloaded free of charge from www.epluse.com/pcs10
- Modbus protocol in the register 60001 (0x00) and 60002 (0x01).
  See Modbus Application Note AN0103 (available at www.epluse.com/ee160)

The serial number as ASCII-code is located in read-only registers 1 - 8 (0x00 - 0x07, 16 bits per register).
The firmware version is located in register 9 (0x08) (bit 15...8 = major release; bit 7...0 = minor release).
The sensor name as ASCII-code is located in read-only registers 10 - 17 (0x09 - 0x11, 16 bits per register).

The beforementioned registers can be read out with function code 0x03 or 0x04.

NOTICE

When reading information that spans multiple registers, it is always necessary to read all registers, even if the desired information requires less.

NOTICE

For obtaining the correct floating point values, both registers have to be read within the same reading cycle. The measured value can change between two Modbus requests, exponent and mantissa may get inconsistent then.

INFO

The Modbus function codes mentioned throughout this document shall be used as described in the MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b3, chapter 6:
www.modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf

Communication settings (INT16)

Parameter	Register number[1] [Dec]	Register address[2] [Hex]	Size[3]
Write register: function code 0x06			
Modbus address[4]	1	00	1
Modbus protocol settings[4]	2	01	1

Device information (INT16)

Parameter	Register number[1] [Dec]	Register address[2] [Hex]	Size[3]
Read register: function code 0x03 / 0x04			
Serial number (as ASCII)	1	00	8
Firmware version	9	08	1
Sensor name (as ASCII)	10	09	8

1) Register number (decimal) starts from 1.
2) Register address (hexadecimal) starts from 0.
3) Number of registers
4) For Modbus address and protocol settings see Application Note Modbus AN0103 (available at www.epluse.com/ee160).

Tab. 4 EE160 registers for device setup

5.5.4. Modbus Register Map

The measured data is saved as a 32 bit floating point values (data type FLOAT) and as 16 bit signed integer values (data type INTEGER).

FLOAT32

Parameter	Unit	Register number[1] [DEC]	Register address[2] [HEX]
Read register: function code 0x03 / 0x04			
Temperature T	°C, °F[3]	26	19
Relative humidity RH, Uw	%RH	28	1B

1) Register number starts from 1.
2) Register address starts from 0.
3) The choice of measurement units (metric or non-metric) is done at the time of ordering, see the ordering guide in the EE160 data sheet. It is not possible to switch from metric to non-metric or vice versa by means of the PCS.

INT16

Parameter	Unit	Scale[1]	Register number[2] [DEC]	Register address[3] [HEX]
Read register: function code 0x03 / 0x04				
Temperature T	°C, °F[4]	100	301	12C
Relative humidity RH, Uw	%RH	100	302	12D

1) Example: For scale 100, reading of 2550 is equivalent to 25.5.
2) Register number starts from 1.
3) Register address starts from 0.
4) The choice of measurement units (metric or non-metric) shall be done when ordering, see the ordering guide in the datasheet. Switching from metric to non-metric or vice versa using the PCS is not possible.

Tab. 5 EE160 registers for device setup

5.5.5. Modbus RTU Example

The EE160's Modbus address is 245 [0xF5].

Please refer to

- MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b3, chapter 6: www.modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf
- E+E Application Note Modbus AN0103 (available at www.epluse.com/ee160)

Read the temperature (FLOAT32) T = 23,290008 °C from register address 0x19:

Master (e.g. PLC) → **EE160**

Request [Hex]:

Modbus address	Function code	Starting address Hi	Starting address Lo	Qty. of registers Hi	Qty. of registers Lo	CRC	
F5	03	00	19	00	02	01	0F

Response [Hex]:

Modbus address	Function code	Byte count	Register 1 value Hi	Register 1 value Lo	Register 2 value Hi	Register 2 value Lo	CRC	
F5	03	04	51	F0	41	BA	98	10

Tab. 6 Example temperature query

Decoding of floating point values:

Floating point values are stored according to IEEE754. The byte pairs 1, 2 and 3, 4 are transformed as follows (numbers taken from T reading Modbus request/response example above):

Modbus response [Hex]			
Register 1 Hi	Register 1 Lo	Register 2 Hi	Register 2 Lo
51	F0	41	BA
MMMMMMMM	MMMMMMMM	SEEEEEEE	EMMMMMMM

Tab. 7 Modbus response

IEEE754			
Register 2 Hi	Register 2 Lo	Register 1 Hi	Register 1 Lo
41	BA	51	F0
0100 0001	1011 1010	0101 0001	1111 0000
SEEE EEEE	EMMM MMMM	MMMM MMMM	MMMM MMMM
Decimal value: 23.290008			

Tab. 8 Data representation according to IEEE754

6 Maintenance and Service

6.1 Cleaning the Sensing Head and Filter Replacement

Cleaning the sensing head:
Use in polluted environment might rise the need for cleaning the sensing head and replacing the filter cap. In such a case refer to “Cleaning Instructions” at www.epluse.com/ee160.

When employed in dusty, polluted environment:
- The filter cap shall be replaced once in a while with an E+E original one. A polluted filter cap causes longer response time of the device.
- If needed, the sensing head can be cleaned. For cleaning intructions refer to www.epluse.com/ee160.

PLEASE NOTE

While replacing the filter cap take very good care to not touch or rub the sensing element.

6.2 RH and T Adjustment and Calibration

Definitions
- **Calibration** documents the accuracy of a measurement device. The device under test (specimen) is compared with the reference and the deviations are documented in a calibration certificate. During the calibration, the specimen is not changed or improved in any way.
- **Adjustment** improves the measurement accuracy of a device. The specimen is compared with the reference and brought in line with it. An adjustment can be followed by a calibration which documents the accuracy of the adjusted specimen.

Humidity calibration and adjustment
Depending on the application and the requirements of certain industries, there might arise the need for periodical humidity calibration (comparison with a reference) or adjustment (bringing the device in line with a reference).

Calibration and adjustment at E+E Elektronik
Calibration and/or adjustment can be performed in the E+E Elektronik calibration laboratory. For information on the E+E capabilities in ISO or accredited calibration please see www.epluse.com.

Calibration and adjustment by the user

Depending on the level of accuracy required, the humidity reference can be:

- Humidity Calibrator (e.g. Humor 20), please see www.epluse.com.
- Handheld Device (e.g. Omniport30), please see www.epluse.com/omniport30.
- Humidity Calibration Kit (e.g. E+E Humidity Standards), please see www.epluse.com/ee160.

6.3 Display Change

NOTICE

Disconnecting or connecting the display while the EE160 is powered may cause damages to EE160 and to the display. Always switch off the EE160 before exchanging the display

The accessory D10P comes with the display included in the top part of the EE160 enclosure. It is intended for replacement only, not for retrofitting an EE160 originally ordered without display.

Procedure for Display exchange:

1. Strictly observe ESD precautions. The sensing elements and the electronics board are ESD (electrostatic discharge) sensitive components of the device and must be handled as such. The failure to do so may damage the device by electrostatic discharges when touching exposed sensitive components.
2. Switch off the power supply of the EE160.
3. Open the FFC Connector and plug off the FFC cable from the display PCB included in the top part of the EE160 enclosure.
4. Connect the FFC cable to the new display. Please observe the correct orientation. The blue cable stiffener needs to be visible as shown in Fig. 18.
5. Switch on power supply to bring the EE160 back into operation.

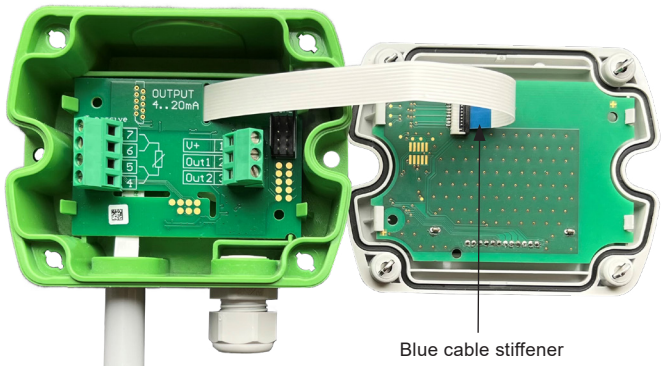


Fig. 18 Correct connection of the display FFC cable

6.4 Repairs

Repairs may be carried out by the manufacturer only. The attempt of unauthorized repair excludes any warranty claims.

7 Accessories

For further information see datasheet Accessories.

Accessories	Code
E+E Product configuration software (Free download: www.epluse.com/pcs10)	**PCS10**
Power supply adapter	**V03**
Protection cap for Ø12 mm probe	**HA010783**
USB-C configuration stick	**HA011070**

EE160 configuration with legacy sensing element (see chapter 5.3)

E+E Product configuration software (Free download: www.epluse.com/configurator)	**EE-PCS**
E+E Product Configuration Adapter + EE160 Cable Analogue	**EE-PCA + HA011059**

8 Technical Data

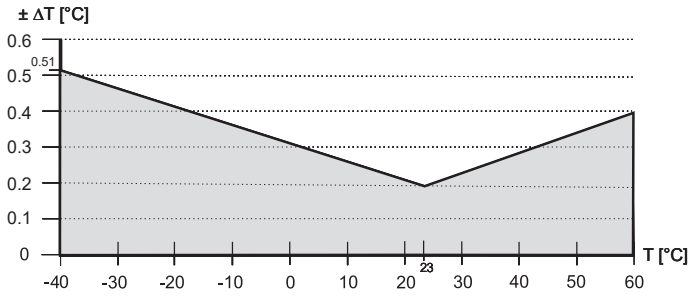
Measurands

Relative Humidity (RH)

Measuring range	0...100 %RH, non-condensing	
Accuracy[1] (incl. hysteresis, non-linearity and repeatability)		
23 °C[2] **(0…100 %RH)**	±2 %RH	
0…+40 °C (0…100 %RH)	±2.5 %RH	
-20…+60 °C (0…100 %RH)	±3.5 %RH	
-40…-20 °C (0…100 %RH)	±4.5 %RH	
Factory calibration uncertainty[3]		
0...90 %RH	±(0.7 + 0.003 * mv) %RH	mv = measured value
>90...100 %RH	±1 %RH	

1) Defined against E+E calibration reference.
2) ±0.02 %RH / °C in the range of 23 °C ±10 °C (73.4 °F ± 18 °F)
3) Defined at 23 °C (73,4 °F) with an enhancement factor k=2, corresponding to a confidence level of 95 %.

Temperature (T)

Measuring range	-40...+60 °C (-40...+140 °F)
Accuracy[1]	
Factory calibration uncertainty[2]	±0.1 °C (±0.056 °F)

1) Defined against E+E calibration reference.
2) Defined at 23 °C (73,4 °F) with an enhancement factor k=2, corresponding to a confidence level of 95 %.

Outputs

Analogue

RH: 0...100 %, T: see ordering guide	4 - 20 mA (2-wire) 0 - 10 V	R_L ≤ 500 Ω 0 mA < I_L < 1 mA	R_L = load resistance I_L = load current
Accuracy @23 °C (68 °F)	± 0.075 % fs		fs = full scale (20 mA, 10 V)

T Sensor Passive

Type acc. to ordering code	4-wire connection

Digital

Digital interface	RS485 (EE160 = 1 unit load)
Protocol **Factory settings** **Supported baud rates** **Data types for measured values**	Modbus RTU Baud rate acc. to ordering code, parity even, 1 stop bit, Modbus address 245 9 600, 19 200, 38 400, 57 600, 76 800 and 115 200 FLOAT32 and INT16

General

Power supply class III USA & Canada: Class 2 supply necessary, max. voltage 30 V DC	**4 - 20 mA (2-wire)**	(10 V + R_L * 20 mA) < V+ < 35 V DC		
	0 - 10 V **RS485**	15 - 35 V DC or 24 V AC ±20%		
Current consumption, typ.		**4 - 20 mA output**	**0 - 10 V output**	**RS485**
	24 V DC supply	According to output current, max. 40 mA	<3 mA / <5 mA with Display	5 mA
	24 V AC supply	-	<8 mA_{rms} / <10 mA_{rms} with Display	15 mA_{rms}
Electrical connection	Screw terminals max. 1.5 mm^2 (AWG 16)			
Cable gland	M16x1.5			
Display[1)]	LC display with two lines for RH and T values			
Temperature range		**Without display**	**With display**	
	Operation	-40...+60 °C (-40...+140 °F)	-20...+60 °C (-4...+140 °F)	
	Storage	-40...+60 °C (-40...+140 °F)	-20...+60 °C (-4...+140 °F)	
Enclosure **Material** **Protection rating**	Polycarbonate (PC), UL94 V-0 approved IP65 / NEMA 4X			
Electromagnetic compatibility	EN 61326-1 FCC Part15 ClassA	EN 61326-2-3 ICES-003 ClassA	Industrial environment	
Conformity	EN 45545-2 (HL3)	CE UKCA		

1) For display operation with EE160-MxA6 (4 - 20 mA, 2-wire) both outputs must be connected.

Accuracy of E+E Humidity and Temperature Sensors

The measurement accuracy depends both on the performance of the measuring instrument and on the correct installation in the application.

For best accuracy, every E+E RH and T sensor is multipoint factory adjusted and calibrated in a highly stable RH / T reactor. Using a high-precision dew point mirror as reference, the overall uncertainty of the factory calibration U_{cal} is minimal.

The total measurement uncertainty U_{total} for E+E sensors is calculated in accordance with EA-4/02 (European Accreditation, Evaluation of the Measurement Uncertainty in Calibration) and with GUM (Guide to the Expression of Uncertainty in Measurement) as follows:

$$U_{total} = k \bullet \sqrt{\left(\frac{U_{cal}}{2}\right)^2 + \left(\frac{u_{accuracy}}{\sqrt{3}}\right)^2}$$

U_{total} .....total accuracy incl. factory calibration
U_{cal}.....the uncertainty of the factory calibration
$u_{accuracy}$...the accuracy of the measurement device
k.....enhancement factor k=2, corresponding to a confidence level of 95 %.

For external calibrations, U_{total} is to be used as the evaluation criterion. The calculation does not include effects due to long-term drift or chemical exposure.

As designated laboratory (NMI) responsible for maintaining the National Standard for humidity and temperature in Austria, E+E Elektronik represents the highest instance in humidity and temperature calibration.

9 Conformity

9.1 Declarations of Conformity

E+E Elektronik Ges.m.b.H. hereby declares that the product complies with the respective regulations listed below:

CE European directives and standards.

and

UKCA UK statutory instruments and designated standards.

Please refer to the product page at www.epluse.com/ee160 for the Declarations of Conformity.

9.2 Electromagnetic Compatibility

EMC for industrial / basic environment.
Our sensors are group 1 devices and correspond to class A.

⚠ WARNING

This device is not intended for use in residential areas and cannot ensure adequate protection of radio reception in such environments.

9.3 FCC Part 15 Compliance Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

9.4 ICES-003 Compliance Statement

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

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